Methyl bromide alternatives

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USDA

From the Acting Deputy Under Secretary for Research, Education, and Economics

As you may know, last year the U.S.-Israel Science and Technology Foundation made funds available for research and development of methyl bromide alternatives, emissions reduction, and improved ways to apply the chemical. We sent out a formal request for proposals with a submission deadline of December 31, 1996.

The Board of Directors of the Foundation is happy to announce that the following three proposals have been selected for funding:

Reducing Methyl Bromide Emission During Soil Fumigation by Using Virtually Impermeable films and Improved Delivery. Companies: Plastopil Hazorea (Israel) and Tri-Cal, Inc. (U.S.A.). By using gas-tight films, improved delivery technology, and reduced dosages of methyl bromide, this project seeks to produce a new soil fumigation package that will improve environmental quality. Research should improve trade benefits of the U.S. and Israel as well as provide an economic package to farmers.

Developing Alternative Fumigation Systems and Methods to Reduce Methyl Bromide emission in Postharvest Treatments. Companies: Haogenplast, Ltd. (Israel) and GrainPro, Inc. (U.S.A.). In addition to improving technologies that will ensure gas-tightness to reduce dosage levels of methyl bromide, this proposal will combine MeBr treatments with CO_2. Thus insect control can be achieved at lower methyl bromide concentrations. This approach is expected to reduce emissions from structural fumigations by 75 percent.

Methyl Bromide Alternatives: Development of Biocontrol Agents for the Control of Soilborne Plant Pathogens and Nematodes. Companies: Mycontrol Ltd. (Israel) and Thermo TrilogyCorp. (U.S.A.). By controlling and preventing damage caused by soilborne pathogens and nematodes, this group expects to enhance plant growth and yield. Novel and inexpensive preparations of biocontrol agents will be developed from *Trichoderma* or other microorganisms supplied by Mycontrol and Thermo Trilogy products.

This issue and all back issues of the *Methyl Bromide Alternatives* newsletter are now available on the Internet at **<http://www.ars.usda.gov/is/np/mba/mebrhp.htm>**. Visit the ARS methyl bromide research homepage at **<http://www.ars.usda.gov/is/mb/mebrweb.htm>**.

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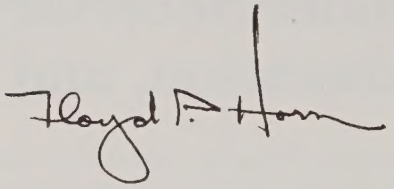
This newsletter provides information on research for methyl bromide alternatives from USDA, universities, and industry.

Address technical questions to Kenneth W. Vick, USDA, ARS, National Program Staff, Bldg. 005, Room 237, BARC-West, 10300 Baltimore Ave. Beltsville, MD 20705. Phone (301) 504-5321, Fax (301) 504-5987.

Address suggestions and requests to be added to the mailing list to Doris Stanley, USDA, ARS, Information Staff, 6303 Ivy Lane, Room 444, Greenbelt, MD 20770. Phone (301) 893-6727, Fax (301) 705-9834.

These proposals bring a total of nearly $3 million to our funding efforts to find effective alternatives to methyl bromide. A plan to commercialize research results from these proposals is required to be in place within 48 months from the beginning of the projects.



Floyd P. Horn
Acting Deputy Under Secretary

Louisiana: Growing Strawberries Without Methyl Bromide

Although California and Florida are the major strawberry producers, growers in several other States have been planting small acreage for local consumption for years. Methyl bromide has been the fumigant of choice for these small growers.

With only a few more seasons left before the 2001 ban on methyl bromide, Louisiana strawberry growers are looking for alternatives to keep their production in step with local demand.

"We're trying chemical alternatives as well as organic soil amendments," says Roy J. Constantin. He is Director of the Hammond Research Station, which is part of the Louisiana State University's Agricultural Center, Louisiana Agricultural Experiment Station. "And although we only have 1 year's data analyzed, we're encouraged with the results from both of these research projects. Compared with methyl bromide, yields from both projects were not significantly different."

Trying a Chemical Alternative

At the Hammond location, Constantin and colleague J. P. Quebedeau fumigated test plots with Vapam, Basamid, and methyl bromide, and had a control plot without fumigation. They applied the fumigants to the fine sandy loam soil on September 30, 1994, using 100 gallons of Vapam, 350 pounds of Basamid, or 250 pounds of methyl bromide per acre, and immediately covered all the plots with 1.25 mil black polyethylene mulch.

"We transplanted Chandler strawberry plants on October 24 and followed cultural practices recommended by the Louisiana Cooperative Extension Service for frost protection, irrigation, insect and disease control throughout the growing and harvesting stages," Constantin explains.

"At spring harvest, we found no significant differences in yield of marketable strawberries between plots treated with Vapam and Basamid and those treated with methyl bromide. Low yields occurred in all test plots because of anthracnose, a fungal disease that attacks strawberries.

"In pounds of berries per acre, marketable yields were 4,734 for the control plot; 4,913, Vapam; 5,357, Basamid; and 5,516, methyl bromide."

Organic Soil Amendments

The fine sandy loam soil of southern Louisiana contains only about 0.05 percent organic matter. Constantin and Louisiana State University colleagues added five organic mixtures to the soil in strawberry field plots in October 1995. James Magee, based at ARS' Small Fruit Research Laboratory in Poplarville, MS, is doing chemical and quality analyses of the fruit.

"Initially, we applied 10 tons per acre of either hardwood bark, cottonwood bark, crab meal, sewage sludge, or cotton gin waste," Constantin says. "We used a cultivator shank to open the beds and incorporated the organic matter with a rototiller."

Soil samples showed only two plots with a few nematodes, with the remaining plots completely free of infestation.

As with the chemical test plots, black plastic mulch was laid before strawberry plants were transplanted in November, and conventional cultural practices were followed until harvest, which lasted from late March until the middle of May 1996. Late harvest was due to an extremely harsh winter in 1995-96 for early season strawberries in southeastern Louisiana. Berries were produced over a 4- to 5-week period instead of the normal 8 or 9 weeks.

"We had temperatures that dipped down to 13 degrees F in February and down to 22 degrees F in March, which is unusual for southern Louisiana," Constantin says. "So, production was reduced and delayed substantially. But there were no significant differences in yield of marketable or cull

fruit due to use of the soil amendments.

"According to Constantin, the experiment was done in part to see if the added organic matter would decrease diseases. None of the amendments decreased disease incidence. And without methyl bromide, weeds were a problem. Weeds around plants were hand-pulled, but the herbicide Gramoxone was used for weed control in the middle of the beds.

There were yield differences among the amendments. Plants grown in soil treated with crab meal produced the highest percentage of marketable fruit, and plants grown with cottonwood bark, the least. Plots treated with sewage sludge produced almost 3,000 pounds more per acre than plots treated with cottonwood bark. The assumption is that the bark needs time to decompose before the soil can benefit from its organic matter. This is the first year of a proposed 5-year project.

Total yield of strawberries from plots treated with sewage sludge was 9,533 pounds per acre; crab meal, 8,929; control, 8,196; cotton gin waste, 7,718; hardwood bark, 7,340; and cottonwood bark, 6,536. These yields were much higher than those from the fumigant study; however, Constantin says the two experiments were conducted on separate fields on the research station and were planted at different dates, so they can't be compared with each other. Also, anthracnose infestation was very light in the test plots treated with organic amendments but had been a major problem in the fumigant study.

"We're going to repeat these experiments this fall and hope that yields will increase, especially in cottonwood-bark-treated plots, since more time will allow further breakdown of organic compounds in the bark," Constantin reports.

"We feel that these research projects show that our southeastern Louisiana growers who plant a few acres of strawberries for local consumption or for sale to Baton Rouge and New Orleans markets will be able to survive without methyl bromide, although some chemical will be necessary to control weeds."

Reduced Dose of Methyl Bromide Controls Verticillium Wilt on Potatoes in Israel

Methyl bromide is important for controlling verticillium wilt and other soilborne pathogens that attack various crops in Israel, as well as other countries of the world. With the approaching ban on the chemical and the regulation to reduce consumption, Israeli scientists are seeking ways to reduce the amount of the fumigant needed and still maintain high crop yields.

A team of Israeli scientists has successfully controlled verticillium wilt of potato by using a reduced dose of methyl bromide under gas-impermeable films. The results were published in *Plant Disease*, May 1997.

These films retain higher concentrations of methyl bromide in the soil for a longer time than the commonly used low-density polyethylene films. As a result, the team cut the standard methyl bromide dose in half and still effectively controlled verticillium.

Potato yields in fumigated plots with these films were up to 69 percent higher than in non fumigated plots, and tuber quality was also improved.

The members of the team are A. Gamliel and A. Grinstein, The Volcani Center; Y. Peretz, Hevel Maon; L. Klein, Bromine Compounds, Ltd.; A. Nachmias, L. Tsror, and L. Livescu, Gilat Experiment Station; and Jaacov Katan, Department of Plant Pathology, The Hebrew University of Jerusalem.

Verticillium wilt is a common disease of potatoes in Israel and in other regions of the world, including the United States. In severe cases, it causes plants to collapse before the end of the season, stunting the growth of potatoes and significantly decreasing yield. In some areas of Israel, two successive crops of potatoes are grown, while other areas rotate potatoes with peanuts, a crop that is also highly susceptible to *Verticillium dahliae*, the fungus that causes the wilt. This rotation practice tends to create a buildup of the pathogen in the soil.

Studies in the Netherlands had demonstrated that gas-impermeable films minimize the escape of methyl bromide from the soil, allowing dosage reduction without affecting pest control. The aim of this study was not only to evaluate the effectiveness of the gas-impermeable film with reduced amounts of methyl bromide to control verticillium in potato, but also to improve yield and quality in one or two successive seasons in experimental or commercial plots, under actual farmers' conditions.

The team conducted three field experiments in southern Israel from 1993 to 1995 in loessial—a loamy, sandy soil. A field with a long history of potato cropping and naturally infested with *V. dahliae* was selected for the first experiment in the fall of 1993. Both the second site, chosen in the spring of 1994, and the third site, chosen the same year in the fall, had similar histories.

For the first and second experiments, at the end of August the team applied methyl bromide at 50 g/m^2 and 25 g/m^2, manually covering the soil with low-density films with edges buried in trenches 20 cm deep, or at 25 g/m^2 with gas-impermeable films. They buried naturally produced *V. dahliae* microsclerotia from infected

potato stems at 20 cm and 40 cm and assessed their control by fumigation.

Experiment three was carried out on a commercial scale in large plots to verify, under farmers' conditions, the effectiveness of reduced dosage of methyl bromide with gas-impermeable films. Using commercial equipment, a contractor mechanically laid plastic tarping and applied the fumigant. The plastic films were kept on all plots for 5 days and were then removed manually. Field preparation at each site included pre-irrigation, broadcast application of composted cow manure, and bed-shaping before fumigation— all common cultivation practices followed by commercial potato producers in this region of the country.

In experiments one and two, all methyl bromide treatments resulted in 100 percent control of *V. dahliae* microsclerotia at both depths. First symptoms of wilt appeared in untreated plots 70 days after planting, followed shortly thereafter by early dying.

In all experiments, verticillium wilt was effectively controlled by methyl bromide at the commercial rate of 50 g/m^2 under low-density films and at 25 g/m^2 under gas-impermeable film. In comparison, fumigation at 25 g/m^2 under low-density films was less effective. Even methyl bromide applied at 15 g/m^2 under gas-impermeable film gave good control. Tuber yield in all fumigation treatments was higher than that in untreated plots.

Using gas-impermeable films and reduced amounts of methyl bromide demonstrated good pathogen control, maintained chlorophyll content of plants, reduced disease incidence and severity, and increased yields and quality. These effects were repeated for two consecutive seasons and results were verified at all test sites including the commercial plots, indicating a high reproducibility of the results.

These research results indicate that using gas-impermeable films can cut at least in half the amount of methyl bromide needed to be effective in controlling verticillium wilt in potato crops. Combining this with other control measures such as solarization, biocontrol agents, disease-resistant plant varieties, and cultural methods will help further reduce methyl bromide emissions without affecting pest control.

In Israel, Italy, Greece, and Spain, reduced methyl bromide dosage using gas-impermeable films has produced similar results in effectively controlling a variety of pathogens such as *Fusarium*, *Phytophthora*, and *Pythium*. This indicates that this approach has potential for wide applicability.

Portable Unit Sterilizes Soil

A portable steam generator is being used on a small scale by the nursery industry to sterilize soil without chemicals. John Gray, marketing manager for the Sioux Steam Cleaner Corporation in Beresford, SD, says that the unit has been used successfully in greenhouses for more than 20 years.

"We've used this system to kill molds, fungi, nematodes, weed seeds, and other soil pathogens that attack cut flowers, bedding plants, potted plants, and vegetables. It is also excellent for sterilizing nursery tools, pots, floors, and other surfaces that can be contaminated by pathogens," Gray says. "It is an ideal technology for sterilizing soil as well as soilless growing mixes to produce disease- and insect-free plants."

Called Steam Flo, the steel generator is designed for growers who want a mobile steam source. Mounted on two 15-inch wheels and equipped with a trailer hitch, it can be moved as necessary from place to place by hand or truck and can sterilize a 5-foot x 50-foot bench in about 2 hours.

Steam Flo produces steam at full operating pressure in just 15 to 20 minutes from the time it is connected to a water supply and plugged into a standard 115-volt electrical outlet. Unlike boilers, this unit will provide quick, portable steam and can be used as a supplemental steam source, so the boiler does not need to be fired up for small projects. If extra heat for short periods of time is needed, the generator can be hooked to hot water lines with a circulating pump or steam line for perimeter heat in hotbeds or plastic houses.

"There is no recovery time and the unit produces 200 pounds of steam per hour, using about $3\frac{1}{2}$ gallons of fuel oil per hour," Gray explains. "And it requires only 37 square feet of floor space."

Proper water level is maintained by a low-water-sensor switch and automatic water feeder. Safety features include a steam pressure relief valve and controls for high pressure and stack pressure.

Gray says that many units built 20 years ago are still in service. The technology has been applied extensively on raised greenhouse beds and soil. Tests and market research are being conducted to determine effectiveness on ground beds and fields. In addition to increasing the efficiency of the oil firing units, the company is adding LP and natural gas units to meet growers' needs.

"Steam is a tried-and-true technology that has been used for over a century. As chemicals are increasingly becoming more regulated, experts in the field are getting more excited about the possibilities of using steam to control pathogens. It is a proven viable technology from an economic and an environmental standpoint," Gray says.

"Now that the ban on methyl bromide is only $3\frac{1}{2}$ years away, we're working to improve the design of our steam generator. Although the unit is not suited to sterilize large fields of soil, we've received a lot of interest from smaller growers of cut flowers, bedding plants, and vegetables."

Oceans Remove More Methyl Bromide From Atmosphere Than Previously Thought

Scientists from the National Oceanic and Atmospheric Administration (NOAA) say that new, possibly biological, oceanic mechanisms are removing more methyl bromide from the atmosphere than has been previously estimated. Their research consequently suggests that the time the chemical stays in the atmosphere is shorter than was previously thought.

The research, conducted by Shari Yvon-Lewis and James Butler, with NOAA's Climate Monitoring and Diagnostics Laboratory in Boulder, CO, was published in the May 1997 issue of *Geophysical Research Letters*.

Yvon-Lewis and Butler calculate the lifetime of methyl bromide in the atmosphere to be about 0.7 years. This is a significant reduction from an estimated 2.0 years in 1992, which was based upon loss due to atmospheric chemistry alone. They arrived at the new, low figure after analyzing 40 years of wind speeds and ocean temperatures across the globe as well as recent measurements of methyl bromide concentrations from research cruises and laboratory studies. They also included recently published results for losses to soils.

"It now appears that loss of atmospheric methyl bromide to the ocean is just about as fast as oxidation in the atmosphere, which has been considered the primary mechanism for removing the chemical," Butler says.

Bromine, a chemical derived from methyl bromide, is thought to be about 50 times more effective in depleting stratospheric ozone than chlorine, the principal chemical that destroys ozone.

"Unlike other ozone depletors, such as chlorofluorocarbons and halons, which are entirely manmade, methyl bromide comes from both natural and manmade sources," Butler reports. "Major manmade sources include biomass-burning and fumigating soils, produce, and buildings."

Fumigation emissions may constitute 20 to 30 percent of all methyl bromide produced, but further research is being done to refine this estimate. Butler says that although there is still some uncertainty, studies suggest that manmade methyl bromide could be responsible for 3 to 10 percent of global stratospheric ozone destruction.

Earlier this year NOAA scientists completed a study which showed that the waters near antarctica remove methyl bromide from the atmosphere. It had previously been suggested that these waters, unlike most of the open ocean, could be a large source of methyl bromide. NOAA research indicated that some other mechanisms were also responsible for degrading methyl bromide in seawater.

"We know that in the ocean, dissolved methyl bromide is further broken down by hydrolysis and chloride substitution," Butler reports. "But recently it has been shown that methyl bromide also undergoes biological degradation, perhaps as a result of bacterial uptake. Field studies, showing large undersaturations in polar and subpolar waters, also suggest an additional sink mechanism."

Heretofore, he says, calculations of methyl bromide loss to the ocean have been based only on chemical degradation mechanisms. Including the biological terms increases the calculated strength of the oceanic sinks, leading to a shorter atmospheric lifetime.

Methyl Bromide on the Internet

Below is a list of Internet addresses that give information on methyl bromide web sites and related resources.

http://www.ars.usda.gov/is/mb/mebrweb.htm
Summarizes methyl bromide research being done by scientists at several laboratories of USDA's Agricultural Research Service. Links to the *Methyl Bromide Alternatives* newsletter.

http://www.epa.gov/docs/ozone/mbr/mbrqa.html
U.S. Environmental Protection Agency, Stratospheric Ozone Methyl Bromide Information Site
Includes regulatory information on the phase-out of methyl bromide.

http://www.acd.ucar.edu/gpdf/ozone/mp/
Montreal Protocol Homepage
Gives an overview of the *Montreal Protocol on Substances that Deplete the Ozone Layer* and lists meetings and reports.

http://www.teap.org/
Technology and Economic Assessment Panel
Links and provides information on the seven technical options committees.

http://www.ussl.ars.usda.gov/METHBROM/mebr.htm
United States Salinity Laboratory, USDA, Agricultural Research Service
Highlights methyl bromide emission and reduction research.

http://www.unep.org
United Nations Environment Programme
Details information about the organization, environmental issues, and links to other environment organizations.

http://www.acd.ucar.edu/gpdf/ozone/
Stratospheric Ozone Law, Information & Science
Includes information and pointers to information on the ozone layer.

http://www.environ.com/ozdep.htm
Environmental Support Solutions
Provides text of the *Executive Summary from the Scientific Assessment of Ozone Depletion.*

http://www.pwc.bc.doe.ca/ep/ozone/ods.html
Environment Canada
Highlights information on ozone depletion.

http://www.ozone.org/index.html
Ozone ACTION
Contains information on methyl bromide, ozone depletion, and links to other related sites.

http://www.al.noaa.gov/#Home
National Oceanic and Atmospheric Administration
Summarizes environmental research and information.

http://www.envirolink.org/EnviroLink_Library/
EnviroLink Library
Dives a comprehensive list of links to environmental information on the Internet.

http://www.ewg.org/pub/home/Reports/Reports.html
Environmental Working Group
Includes various pesticide reports and other information on methyl bromide.

http://www.ifgb.uni-hannover.de/extern/ppigb/ppigb.htm
Plant Pathology Internet Guide Book
Provides a subject-oriented Internet resource guide for phytopathology, applied entomology, and related fields and information on pesticides, databases, and links to other sites.

Technical Reports

Summary of 1991-96 Research to Develop a Multiple Quarantine Treatment for Compressed Hay Exported to Japan

Principal Investigators: Victoria Y. Yokoyama, Research Entomologist, and Gina T. Miller, Biological Science Technician, Horticultural Crops Research Laboratory, USDA, ARS, Fresno, CA 93727

Collaborators: National Hay Association, Organization of Kittitas County Timothy Hay Growers and Suppliers, and the California Department of Food and Agriculture

A multiple quarantine treatment to control Hessian fly in compressed hay exported to Japan was approved in December 1996 and the first shipments of hay certified free of Hessian fly under the new treatment program arrived in Japan in February 1997. The U.S. market for hay exported to Japan is valued at $240 million annually. Through competitive pricing, the multiple quarantine treatment will generate increased demand for U.S. hay and it will ensure a constant supply of quality hay for the racehorse, dairy, and beef industries in Japan.

Compressed bales of hay exported to Japan are inspected for plant hosts of Hessian fly upon entry. The occurrence of such hosts has resulted in rejections of shipments that have been costly to the hay export industry. Hessian fly is not found in Japan and is of regulatory importance to the Japan Ministry of Agriculture, Forestry and Fisheries. A certified fumigation program for standard bale timothy hay was developed by the USDA-ARS in the 1970's but the procedure is not currently economically competitive with compressed bales of timothy hay exported from other countries.

Timothy, alfalfa, oat, Bermuda grass, Sudan grass, and rye straw are the primary species of hay exported from the U.S. to Japan. Research began in 1991 to develop a postharvest treatment to control Hessian fly in these hays. Compression of standard bales, a normal hay handling process for exports, followed by fumigation with hydrogen phosphide was developed as a multiple quarantine treatment. The results of dose-response tests were used to determine levels of fumigant needed to control the Hessian fly puparia, the life stage that may occur in hay. The fumigation phase of the treatment was established at 60 g/28.3 m^3 aluminum phosphide for 7 days at 20°C.

The basis of the multiple quarantine treatment is compression of standard size bales into compact bales. A greater quantity of bales can be loaded in freight containers after compression. Compressed hay is economically priced because the bales are easily handled by specialized machinery and generate a greater savings in ocean freight. Compression monitoring equipment in laboratory tests showed the effect of compression on survival of Hessian fly puparia. The relationship between insect mortality and amount of pressure on the bales was shown in field tests using variable forces produced by several commercial hay compressors. Research showed that compression alone at 80 kg/cm^2 or more controlled large populations of Hessian fly puparia placed in the bales. Compression has potential as a single quarantine treatment to ensure that Hessian fly would not be accidentally introduced into Japan through hay shipments.

Seasonal weather conditions and hay harvesting practices including cutting, drying, wind rowing, baling, and curing were shown to control Hessian fly puparia in laboratory and field tests. A survey of the distribution of Hessian fly in California revealed that infestations did not occur in wheat. Such cultural factors indicate that Hessian fly would not be found in export quality hays that were not biological hosts for this pest.

Two large-scale tests of the multiple quarantine treatment in 1995 resulted in 100 percent mortality of a large number of test insects. These tests allowed an on-site confirmatory test in the presence of a scientist from the Japan Ministry of Agriculture, Forestry and Fisheries in April 1996. The successful on-site confirmatory test resulted in approval of the treatment.

A recent investigation studied the effects of in-transit conditions that may affect survival of Hessian fly and the quality of hay during shipment by ocean freight. Also, film-wrapped bales have been in demand in Japan and studies have been initiated to determine the effect of film wrapping on the efficacy of the multiple quarantine treatment. Hay exporters have requested that the fumigation phase of the treatment be modified to shorten the time and lower the temperature of the fumigation. Such modifications will expedite handling time of shipments and allow fumigation outside of warming barns during the colder periods of the year.

Release of Southern Root-knot Nematode Resistant Bell Peppers 'Charleston Belle' and 'Carolina Wonder'

Pricipal Investigators: Richard L. Fery, Research Geneticist, Philip D. Dukes, Sr., Research Plant Pathologist (retired), and Judy A. Thies, Research Plant Pathologist, U.S. Vegetable Laboratory, ARS, USDA, Charleston, SC 29414-5334

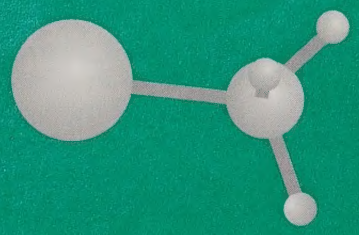
The southern root-knot nematode [*Meloidogyne incognita* (Kofoid and White) Chitwood] is a major pest of bell peppers, and the principal control method at present is soil fumigation with methyl bromide. The southern root-knot nematode is one of the major reasons why peppers account for almost 12% of the preplant methyl bromide utilization in the United States. The ideal solution to this bell pepper pest problem would be the use of resistant cultivars, but none of the commercial cultivars currently available to U.S. growers exhibits an adequate level of resistance. Scientists at the USDA, ARS, U.S. Vegetable Laboratory recognized the need for resistant bell pepper cultivars in the early 1980's, and initiated a breeding program to make them a reality. Their efforts were brought to a successful conclusion earlier this year with the release of the two cultivars, 'Charleston Belle' and 'Carolina Wonder'.

'Charleston Belle' and 'Carolina Wonder' are both products of a conventional recurrent backcrossing procedure to transfer the dominant *N* gene for root-knot nematode resistance from 'Mississippi Nemaheart' into well adapted, commercial-type bell pepper germplasm. 'Charleston Belle' is the result of efforts to incorporate the *N* gene into a 'Keystone Resistant Giant' background, and 'Carolina Wonder' is the result of efforts to incorporate the gene into a 'Yolo Wonder B' background. Both 'Charleston Belle' and 'Carolina Wonder' originated from bulked F_3 populations derived from the sixth backcross.

'Charleston Belle' and 'Carolina Wonder' are similar in appearance and maturity to their respective recurrent parents, 'Keystone Resistant Giant' and 'Yolo Wonder B'. The plants of the new cultivars have compact growth habits and the period from transplanting to first harvest ranges from 63 to 70 days. The results of field experiments conducted at Charleston, SC, indicated that the fruit and yield characteristics of the new cultivars were virtually identical to those of their recurrent parents.

Both of the new cultivars are homozygous for the *N* gene that conditions a high level of resistance to the southern root-knot nematode. The new cultivars have exhibited high levels of resistance in all greenhouse and field tests; the numbers of galls and egg masses on the roots have always been minimal. The results of 1996 tests conducted in greenhouse soil benches infested with *M. incognita* race 3 showed that 'Charleston Belle' roots yielded 93% fewer *M. incognita* eggs per gram than did roots of 'Keystone Resistant Giant'; roots of 'Carolina Wonder' yielded 95% fewer eggs than did roots of 'Yolo Wonder B'. The southern root-knot nematode resistant 'Charleston Belle' and 'Carolina Wonder' are recommended for use by both home gardeners and commercial growers. They are recommended particularly as home garden cultivars because home gardeners do not have easy access to alternative production sites or the needed nematicides and nematicide application equipment. Since the gene conditioning the root-knot nematode resistance trait is dominant, both of the new cultivars are potentially valuable parental lines for developing other root-knot nematode resistant hybrid bell cultivars. Both of the new cultivars should perform well in all areas where their recurrent parents have been grown successfully.

'Charleston Belle' and 'Carolina Wonder' breeder's seeds have been released to seed producers. Small, trial samples of breeder's seed are available for distribution to all interested research personnel. Address all requests for seed to Richard L. Fery, U.S. Vegetable Laboratory, 2875 Savannah Highway, Charleston, SC 29424-5334. Genetic material of these releases will be deposited in the National Plant Germplasm System where it will be available for research purposes, including the development of new cultivars.



Upcoming Meetings

Montreal, Canada—September 15-17, 1997
On-site registration for the Ninth Meeting of the Parties to the Montreal Protocol begins at 9 a.m. on Monday, September 15, in the Atrium of the ICAO Conference Center, 999 University Avenue, Montreal. For more information, contact the Ozone Secretariat, United Nations Environment Programme (UNEP), P.O. Box 30552, Nairobi, Kenya, phone 254-2-62-3851, fax 254-2-62-3913, e-mail <ozoneinfo@unep.org>.

San Diego, California—November 3-5, 1997
The fourth Annual International Research Conference on Methyl Bromide Alternatives and Emissions reduction will be held November 3-5 at the Double Tree San Diego Mission Valley Hotel in San Diego, CA (phone 619-297-5466 or 800-222-8733). Again sponsored by the U.S. Department of Agriculture, the Crop Protection Coalition, and the U.S. Environmental Protection Agency, the conference is being held to:

- Enhance scientific information and data exchange on methyl bromide alternatives research
- Provide a forum for exchange of interdisciplinary scientific and agricultural information
- Develop and distribute conference proceedings as a state-of-the-art methyl bromide alternatives source for researchers, users of methyl bromide, legislators, government policy officials, and the general public
- Support data gathering on potential alternatives to methyl bromide for future evaluation and prioritization
- Monitor development of viable alternatives to methyl bromide
- Evaluate technology transfer processes and incentive programs needed to implement alternatives.

Titles of presentations must be submitted by August 1, 1997. To be included on the agenda, a 2-page written summary of all posters and presentations must be submitted by September 8 to the Methyl Bromide Alternatives Outreach, 144 W. Peace River Drive, Fresno, CA 93711.

For more details, contact Anna Williams, Methyl Bromide Alternatives Outreach, phone (209) 447-2127, fax (209) 436-0692.